What is claimed is:

1. An optical semiconductor device comprising:

a bias layer formed on a semiconductor substrate and made of a first conductivity type semiconductor;

a first optical waveguide formed on the bias layer, and having a stripe-like first core layer that is put between a first upper clad layer and a first lower clad layer made of the first conductivity type semiconductor;

a second optical waveguide formed on the bias layer to be put between a second upper clad layer, which is separated from the first upper clad layer, and a second lower clad layer made of the first conductivity type semiconductor, and having a stripe-like second core layer that is formed separately from the first core layer;

a first phase modulation electrode formed on the first upper clad layer of the first optical waveguide;

a second phase modulation electrode formed on the second upper clad layer of the second optical waveguide;

a first slot-line electrode formed on a side of the first optical waveguide and connected to the first phase modulation electrode via a first air-bridge wiring;

a second slot-line electrode formed on a side of the second optical waveguide and connected to the second phase modulation electrode via a second air-bridge wiring;

a first optical coupler formed over the semiconductor substrate and connected to respective one ends of the first optical waveguide and the second optical waveguide; and

a second optical coupler formed over the semiconductor substrate and connected to respective other ends of the first optical waveguide and the second optical waveguide.

2. An optical semiconductor device according to claim 1, wherein a bias electrode to which a direct current is applied is formed on a part of the bias layer.

3. An optical semiconductor device according to claim 1, wherein respective surfaces of the first upper clad layer and the first lower clad layer, which come into contact with the first core layer, have a substantially same width as the first core layer, and

respective surfaces of the second upper clad layer and the second lower clad layer, which come into contact with the second core layer, have a substantially same width as the second core layer.

4. An optical semiconductor device according to claim 1, further comprising:

a high-resistance semiconductor layer formed on both sides of the first core layer to contact to the first core layer and connected to the first phase modulation electrode via an upper surface, and formed on both sides of the second core layer to contact to the second core layer and connected to the second phase modulation electrode via the upper surface.

5. An optical semiconductor device according to claim 4, wherein a recess whose depth is shallower than the first

core layer and the second core layer is formed in the high-resistance semiconductor layer in an area between the first core layer and the second core layer

6. An optical semiconductor device according to claim 1, wherein the first phase modulation electrode and the second phase modulation electrode are formed in plural at an interval in a light traveling direction respectively.

7. An optical semiconductor device according to claim 6, wherein the first upper clad layer is formed of a second conductivity type semiconductor under the first phase modulation electrode and is formed of the high-resistance semiconductor layer in areas except an area located under the first phase modulation electrode, and

the second upper clad layer is formed of the second conductivity type semiconductor under the second phase modulation electrode and is formed of the high-resistance semiconductor layer in areas except an area located under the second phase modulation electrode.

8. An optical semiconductor device according to claim 1, wherein the first upper clad layer and the second upper clad layer are formed of the second conductivity type semiconductor respectively.

9. An optical semiconductor device according to claim 1, wherein a core layer of a third optical waveguide is formed in the first optical coupler on an opposite side to the first core layer and the second core layer to put the first optical coupler therebetween,

a core layer of a fourth optical waveguide is formed in the second optical coupler on an opposite side to the first core layer and the second core layer to put the second optical coupler therebetween, and

a semiconductor laser having an active layer, which is butt-jointed to an end portion of at least one of core layers of the third optical waveguide and the fourth optical waveguide, is formed on the semiconductor substrate.

10. An optical semiconductor device according to claim 9, wherein the first upper clad layer and the second upper clad layer under the first phase modulation electrode and the second phase modulation electrode are formed of the second conductivity semiconductor, and

a second conductivity type clad layer, which is isolated substantially from the second conductivity type clad layer via the high-resistance semiconductor layer, is formed over the active layer of the semiconductor laser.

11. An optical semiconductor device according to claim 9, further comprising:

a first conductivity type semiconductor layer formed under the first lower clad layer, the second lower clad layer, and the active layer; and

an electrode formed on a part of the first conductivity type semiconductor layer to apply a DC bias voltage to the first conductivity type semiconductor layer.

12. An optical semiconductor device according to claim 1, further comprising:

a phase-difference adjusting electrode formed over the core layer in areas, which are remote from the first phase modulation electrode and the second phase modulation electrode, to apply an electric field to at least one core layer of the first core layer and the second core layer.

13. An optical semiconductor device according to claim 12, wherein a high-resistance semiconductor layer is formed on the core layer in areas between the phase-difference adjusting electrode and the first phase modulation electrode and the second phase modulation electrode.

14. An optical semiconductor device according to claim 12, wherein the phase-difference adjusting electrode formed over the core layer and the first phase modulation electrode or the second phase modulation electrode are connected electrically.

15. An optical semiconductor device according to claim 12, wherein a bias voltage source for applying a DC bias voltage, by which an optical output power in an ON state of a light and an extinction ratio are maximized substantially, is connected to the phase-difference adjusting electrode.

16. An optical semiconductor device according to claim 12, wherein the phase-difference adjusting electrode is formed over both the first core layer and the second core layer respectively, and

a DC bias voltage that is in a range to maximize

substantially an optical output power in an ON state of a light and an extinction ratio at a time of optical modulation operation and reduce a potential difference between two phase-difference adjusting electrodes is applied separately to the two phase-difference adjusting electrodes from a bias voltage source.

17. An optical semiconductor device according to claim 16, wherein a high-frequency electric signal source is connected between two phase-difference adjusting electrodes, and

an electric filter for cutting off a DC component is inserted between the high-frequency electric signal source and at least one of the two phase-difference adjusting electrodes.

18. An optical semiconductor device according to claim 1, wherein the first upper clad layer and the second upper clad layer are formed of the second conductivity type semiconductor, and

at least a part of the first upper clad layer and the second upper clad layer is removed from areas in which the first phase modulation electrode and the second phase modulation electrode are not formed.

19. An optical semiconductor device comprising:

a bias layer formed on a semiconductor substrate and made of first conductivity type semiconductor;

a first optical waveguide formed on the bias layer, and having a stripe-like first core layer that is put

between a first upper clad layer and a first lower clad layer made of the first conductivity type semiconductor and has a width equal to a beam diameter in an electric field distribution in a propagation basic mode of optical waveguides;

a second optical waveguide formed on the bias layer to be put between a second upper clad layer, which is separated from the first upper clad layer, and a second lower clad layer made of the first conductivity type semiconductor, and having a stripe-like second core layer that has a width equal to the beam diameter in the electric field distribution in the propagation basic mode of the optical waveguides;

a first phase modulation electrode formed on the first upper clad layer of the first optical waveguide;

a second phase modulation electrode formed on the second upper clad layer of the second optical waveguide;

a first slot-line electrode formed on a side of the first optical waveguide and connected to the first phase modulation electrode via a first air-bridge wiring;

a second slot-line electrode formed on a side of the second optical waveguide and connected to the second phase modulation electrode via a second air-bridge wiring;

a first optical coupler formed over the semiconductor substrate and connected to respective one ends of the first optical waveguide and the second optical waveguide; and

a second optical coupler formed over the

semiconductor substrate and connected to respective other ends of the first optical waveguide and the second optical waveguide.

20. An optical semiconductor device according to claim 19, wherein a bias electrode to which a direct current is applied is formed on a part of the bias layer.

21. An optical semiconductor device according to claim 19, wherein respective surfaces of the first upper clad layer and the first lower clad layer, which come into contact with the first core layer, have a substantially same width as the first core layer, and

respective surfaces of the second upper clad layer and the second lower clad layer, which come into contact with the second core layer, have a substantially same width as the second core layer.

22. An optical semiconductor device according to claim 19, further comprising:

a high-resistance semiconductor layer formed on both sides of the first core layer to contact to the first core layer and connected to the first phase modulation electrode via an upper surface, and formed on both sides of the second core layer to contact to the second core layer and connected to the second phase modulation electrode via the upper surface.

23. An optical semiconductor device according to claim 22, wherein a recess whose depth is shallower than the first core layer and the second core layer is formed in

the high-resistance semiconductor layer in an area between the first core layer and the second core layer

24. An optical semiconductor device according to claim 19, wherein the first phase modulation electrode and the second phase modulation electrode are formed in plural at an interval in a light traveling direction respectively.

25. An optical semiconductor device according to claim 24, wherein the first upper clad layer is formed of a second conductivity type semiconductor under the first phase modulation electrode and is formed of the high-resistance semiconductor layer in areas except an area located under the first phase modulation electrode, and

the second upper clad layer is formed of the second conductivity type semiconductor under the second phase modulation electrode and is formed of the high-resistance semiconductor layer in areas except an area located under the second phase modulation electrode.

26. An optical semiconductor device according to claim 19, wherein the first upper clad layer and the second upper clad layer are formed of the second conductivity type semiconductor respectively.

27. An optical semiconductor device according to claim 19, wherein a core layer of a third optical waveguide is formed in the first optical coupler on an opposite side to the first core layer and the second core layer to put the first optical coupler therebetween,

a core layer of a fourth optical waveguide is formed

in the second optical coupler on an opposite side to the first core layer and the second core layer to put the second optical coupler therebetween, and

a semiconductor laser having an active layer, which is butt-jointed to an end portion of at least one of core layers of the third optical waveguide and the fourth optical waveguide, is formed on the semiconductor substrate.

28. An optical semiconductor device according to claim 27, wherein the first upper clad layer and the second upper clad layer under the first phase modulation electrode and the second phase modulation electrode are formed of the second conductivity semiconductor, and

a second conductivity type clad layer, which is isolated substantially from the second conductivity type clad layer via the high-resistance semiconductor layer, is formed over the active layer of the semiconductor laser.

29. An optical semiconductor device according to claim 27, further comprising:

a first conductivity type semiconductor layer formed under the first lower clad layer, the second lower clad layer, and the active layer; and

an electrode formed on a part of the first conductivity type semiconductor layer to apply a DC bias voltage to the first conductivity type semiconductor layer.

30. An optical semiconductor device according to claim 19, further comprising:

a phase-difference adjusting electrode formed over

the core layer in areas, which are remote from the first phase modulation electrode and the second phase modulation electrode, to apply an electric field to at least one core layer of the first core layer and the second core layer.

31. An optical semiconductor device according to claim 30, wherein a high-resistance semiconductor layer is formed on the core layer in areas between the phase-difference adjusting electrode and the first phase modulation electrode and the second phase modulation electrode.

32. An optical semiconductor device according to claim 30, wherein the phase-difference adjusting electrode formed over the core layer and the first phase modulation electrode or the second phase modulation electrode are connected electrically.

33. An optical semiconductor device according to claim 30, wherein a bias voltage source for applying a DC bias voltage, by which an optical output power in an ON state of a light and an extinction ratio are maximized substantially, is connected to the phase-difference adjusting electrode.

34. An optical semiconductor device according to claim 30, wherein the phase-difference adjusting electrode is formed over both the first core layer and the second core layer respectively, and

a DC bias voltage that is in a range to maximize substantially an optical output power in an ON state of a

light and an extinction ratio at a time of optical modulation operation and reduce a potential difference between two phase-difference adjusting electrodes is applied separately to the two phase-difference adjusting electrodes from a bias voltage source.

35. An optical semiconductor device according to claim 34, wherein a high-frequency electric signal source is connected between two phase-difference adjusting electrodes, and

an electric filter for cutting off a DC component is inserted between the high-frequency electric signal source and at least one of the two phase-difference adjusting electrodes.

36. An optical semiconductor device according to claim 19, wherein the first upper clad layer and the second upper clad layer are formed of the second conductivity type semiconductor, and

at least a part of the first upper clad layer and the second upper clad layer is removed from areas in which the first phase modulation electrode and the second phase modulation electrode are not formed.